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Robert Grosseteste's *Conclusiones* and the Commentary on the *Posterior Analytics*[1]

David Bloch
University of Copenhagen

Abstract
This article examines the nature of Robert Grosseteste's commentary on Aristotle's *Posterior Analytics* with particular reference to his "conclusions" (*conclusiones*). It is argued (using book 1, chapter 2, of the commentary as a case study) that the simple demonstrative appearance of the commentary, which is very much the result of the 64 conclusions, is in part an illusion. Thus, the exposition in the commentary is not simply based on the strict principles of the *Posterior Analytics* and on the proof-procedures of Euclidean geometry; rather the commentary is a complicated mixture of different elements of twelfth-century texts and the scholarship of Grosseteste's day.

Keywords
Robert Grosseteste, Aristotle, *Posterior Analytics*, medieval logic, demonstrative science

I. Introduction

Robert Grosseteste's commentary on the *Posterior Analytics* is a somewhat idiosyncratic piece of work.[2] It is, of course, a literal commentary, but there is a long way to the more regular type of the thirteenth century. In a relatively recent article, Sten Ebbesen even used the heading "Literal Commentary without Principles" to describe this particular commentary, meaning that Grosseteste does not have a standard procedure in the individual chapters, but

[1] Texts are cited from both printed editions and medieval manuscripts in the present article. However, I have sometimes made changes in orthography and/or punctuation. All translations are my own. I owe thanks to Sten Ebbesen and the editorial board of *Vivarium* for comments and criticism.

[2] Robertus Grosseteste, *Commentarius in Posteriorum Analyticorum Libros*, ed. Pietro Rossi (Firenze 1981).

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rather allows himself to comment, explain, define, conclude etc. in the order he sees fit.[3] In this article I shall examine the commentary and try to establish its nature more precisely. In particular, I shall focus attention on the *conclusiones* as relevant to this purpose.

At first reading the commentary seems to be composed on strict and sound methodological principles. Grosseteste proceeds chapter by chapter—although his divisions into chapters do not always correspond with the ones used nowadays. In each chapter he interprets Aristotle's text, of course, but it is done with the use of his own conceptual tools: "definitions" (*definitiones*), "suppositions" (*suppositiones*) and "conclusions" (*conclusiones*) in particular. The first two correspond roughly to the Euclidean definitions and postulates, whereas the conclusions are apparently supposed to parallel the theorems.[4] In Grosseteste's terminology, definitions set forth the essential descriptions of different items to be used in the argument,[5] and suppositions state truths that cannot be disputed within the science in which they are used; that is, they are hypotheses or, in Euclidean terms, postulates. These two together (definitions and suppositions) form the foundation of Grosseteste's method of exposition, and based on these he states the conclusions which are clearly meant to be conceived as deductions performed on the basis of the definitions, the suppositions and any previous deductions.

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3) S. Ebbesen, 'Medieval Latin Glosses and Commentaries on Aristotelian Logical Texts of the Twelfth and Thirteenth Centuries', in *Glosses and Commentaries on Aristotelian Logical Texts. The Syriac, Arabic and Medieval Latin Traditions*, ed. C. Burnett (London, 1993), 129-77, at 141, 143-44. *Contra* B. G. Dod, 'The Study of Aristotle's *Posterior Analytics* in the Twelfth and Thirteenth Centuries: The Translators, Glossators, and Commentators and Their Methods' (unpublished B. Litt. thesis, Oxford 1970), 98-99, who believes that Grosseteste does use a general standard method of exposition. For an intermediate position, see J. Hackett, 'Robert Grosseteste and Roger Bacon on the *Posterior Analytics*', in *Erkenntnis und Wissenschaft/Knowledge and Science. Probleme der Epistemologie in der Philosophie des Mittelalters/Problems of Epistemology in Medieval Philosophy*, ed. M. Lutz-Bachmann, A. Fidora and P. Antolic (Berlin 2004), 161-212, at 161-64.

4) See also the preface to Version III of Euclid's *Elements*, printed in M. Clagett, 'King Alfred and the Elements of Euclid', *Isis* 45 (1954), 269-77, at 275: "Haec [scil. principia] autem distinguuntur per axiomata, petitiones, et conceptiones. Axioma dignitas interpretatur. Explicat enim rerum definitiones. Petitiones sunt quibus concessis secundum hypothesim nullum sequatur inconveniens".

5) On an Aristotelian theory, one is actually allowed to dispute definitions, but in medieval practice, and certainly in Grosseteste's commentary, definitions seem often to work simply as axioms. See also G. R. Evans, 'Boethian and Euclidean Axiomatic Method in the Theology of the Later Twelfth Century', *Archives internationales d'histoire des sciences* 30 (1980), 36-52, at 50, on Nicholas of Amiens.

Thus, Grosseteste's commentary is not only an interpretation of a text that sets forth a demonstrative method; it is also itself based on demonstrative (axiomatic-deductive) principles. But the tradition of demonstrative science was not completely uniform in Grosseteste's days. In the twelfth century demonstrative theories developed in different directions, and thus the scientific foundation of Grosseteste's work on demonstration and demonstrative methods in the early thirteenth century was potentially very complex. One might say, using a terminology which is partly medieval, that there are three kinds of procedure within the demonstrative texts of the twelfth century:

1. Texts that both (a) demonstrate, while (b) upholding a clear distinction between premisses (axioms) and conclusions (theorems), and (c) teach how to demonstrate. Aristotle's *Posterior Analytics* is, of course, by far the most prominent example, but especially Boethius' *De Hebdomadibus*, lectured on by notable thinkers such as Gilbert of Poitiers and Thierry of Chartres as well as the latter's pupil Clarembald of Arras,[6] and scattered remarks in his other writings (in particular a description of demonstration in Boethius' second commentary on Porphyry's *Isagoge*), were also used as aids.[7]
2. Texts that (a) demonstrate, while (b) upholding a clear distinction between premisses (axioms) and conclusions (theorems), but (c) do not teach how to demonstrate. Euclid's *Elements* is the leading work in this group, but there were others in use, such as Euclid's *Optics*, Archimedes' *On the Quadrature of the Circle* and Ptolemy's *Almagest*.[8]
3. Texts that (a) demonstrate, but (b) do not uphold a clear distinction between the premisses (axioms) and conclusions (theorems); instead

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6) *The Commentaries on Boethius by Gilbert of Poitiers*, edited by N. M. Häring (Toronto, 1966); *Commentaries on Boethius by Thierry of Chartres and his School*, edited by N. M. Häring (Toronto, 1971); *Life and Works of Clarembald of Arras. A Twelfth-Century Master of the School of Chartres*, edited by N. M. Häring (Toronto, 1965).

7) G. Schrimpf, *Die Axiomenschrift des Boethius (De Hebdomadibus) als philosophisches Lehrbuch des Mittelalters* (Leiden, 1966); C. Burnett, 'Scientific Speculations', in *A History of Twelfth-Century Western Philosophy*, ed. P. Dronke (Cambridge, 1988), 151-76.

8) On Euclid in the twelfth century, see e.g. M. Clagett, 'The Medieval Latin Translations from the Arabic of the Elements of Euclid, with Special Emphasis on the Versions of Adelard of Bath', *Isis* 44 (1953), 16-42; J. E. Murdoch, 'The Medieval Euclid: Salient Aspects of the Translations of the *Elements* by Adelard of Bath and Campanus of Novara', *Revue de Synthèse* 89 (1968), 67-94; J. E. Murdoch, 'Euclid: Transmission of the *Elements*', *Dictionary of Scientific Biography* 4 (1971), 437-59. On other mathematical works using demonstrative methods, see Burnett, 'Scientific Speculations', 161-62.

they deduce everything (at least ideally) from a single first proposition. (c) These texts do not teach how to demonstrate. The *Liber de Causis* is the model of this kind of procedure.

The first two kinds are explicitly acknowledged by the medievals,[9] whereas the third kind is implicitly acknowledged, as Charles Lohr has shown.[10] Therefore, Grosseteste is likely to have operated (consciously or unconsciously) with this kind of division of demonstrative sciences. Apparently, these three kinds exhaust the possibilities of demonstration, as it was known and used in the twelfth and early thirteenth centuries.[11]

Grosseteste's commentary on the *Posterior Analytics* is undeniably a demonstrative text. Therefore, we ought to be able to place it in one of these three groups, but the more exact classification depends on the precise nature of his method, and in particular on the *conclusiones*.

In the only study known to me devoted solely to the *conclusiones* in this commentary, Gillian Evans tried to show that Grosseteste was not just being his idiosyncratic self but was actually following a twelfth-century tradition as regards methodology, although the final result was certainly original.[12] Works such as Allan of Lille's *Regulae Caelestis Iuris*[13] and Nicholas of Amiens' *Ars Fidei*

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9) See the preface to Version III of Euclid's *Elements*, printed in Clagett, 'King Alfred and the Elements', 275: "Est autem demonstratio argumentatio, arguens ex primis et veris in illorum conclusionibus. Sic enim ars proposita contexta est quod sequentia necessario accidunt ex premissis aut principiis deinceps. Est enim scientia demonstrativa quae docet demonstrare et demonstrat, ut *Posteriores Analeti(ci)*, et quae demonstrat et non docet demonstrare, ut geometria". A similar view of Aristotle's procedure ("Aristoteles demonstrando docuit demonstrare") is attributed to "Alexander" and accepted in an anonymous set of *quaestiones* in Ms. Cordoba Bibl. del Excellentissimo Cabildo 52: 82ra. See partial edition (including the relevant part) in C. Marmo, 'Anonymus Cordubensis, *Questiones super primum librum Posteriorum*. A Partial Edition: Prologue and qq. 1-5', *CIMAGL* 61 (1991), 107-39.

10) C. H. Lohr, 'The Pseudo-Aristotelian *Liber de Causis* and Latin Theories of Science in the Twelfth and Thirteenth Centuries', in *Pseudo-Aristotle in the Middle Ages*, ed. J. Kraye, W. F. Ryan and C. B. Schmitt (London, 1986), 53-62; Burnett, 'Scientific Speculations', 165-66. See also M. Dreyer, 'Regularmethode und Axiomatik Wissenschaftliche Methodik im Horizont der *artes*-Tradition des 12. Jahrhunderts', in *Scientia und Ars im Hoch- und Spätmittelalter*, ed. I. Craemer-Ruegenberg and A. Speer = *Miscellanea Mediaevalia* 22/1 (Berlin-New York, 1994), 145-57.

11) Of course, one could also distinguish demonstrative theories on the basis of their different uses of axioms, definitions and suppositions (hypotheses/postulates). On this, see Evans, 'Boethian and Euclidean Axiomatic Method'.

12) G. R. Evans, 'The "Conclusiones" of Robert Grosseteste's Commentary on the *Posterior Analytics*', *Studi medievali*, serie terza, 24 (1983), 729-34.

13) Edition in N. M. Häring, 'Alanus de Insulis. *Regulae Caelestis Iuris*', *AHDLMA* (1982),

Catholicae[14] exhibit very similar features in deducing conclusions on the basis of undisputed axioms, and Euclid was the primary foundation, or rather: the major inspiration, of all such attempts.[15] In this way, Grosseteste's commentary becomes an axiomatic-deductive system in which conclusions are deduced from fundamental premisses. Therefore, quite a few scholars have without reflection translated *conclusiones* with the word "theorems".[16] However, in relation to Grosseteste, Evans and others do not seem to take into account that thinkers of the twelfth century did actually distinguish between different sorts of demonstrative theories. Thus, a more precise categorisation of Grosseteste's work can be made, thereby revealing more about its nature and Grosseteste's general methodology. I shall use book 1, chapter 2 (hereafter = 1.2), of his commentary as a case study in which I will focus on the use of the structuralising concepts: definitions, suppositions and, in particular, conclusions. 1.2 may with some justification be called the most important chapter of the work, since it lays the foundation for everything to come.[17]

II. Analysis: *In Analytica Posteriora* 1.2

Grosseteste's 1.2 also corresponds to Aristotle's *Posterior Analytics* 1.2.[18] His 1.1 is introductory and contains no definitions, suppositions or conclusions that form part of the science in question; the chapter is simply used to posit

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97-226. See also Dreyer, 'Regularmethode und Axiomatik', 147-50 and 147 n. 7 for further bibliography.

14) For an edition and interpretation see M. Dreyer, *Nikolaus von Amiens: Ars Fidei Catholicae—Ein Beispielwerk axiomatischer Methode* (Münster, 1993). See also Dreyer, 'Regularmethode und Axiomatik', 146-50.

15) But see also Lohr, 'The Pseudo-Aristotelian *Liber de Causis*' (for use of, and inspiration from, the *Liber de Causis*) and J. Marenbon, 'The Twelfth Century", in *Medieval Philosophy*, ed. J. Marenbon (London-New York, 1998), 150-87, at 177-78 (for the possible influence of Gilbert of Poitiers on the axiomatic-deductive theories of the twelfth century).

16) See e.g. Ebbesen, 'Medieval Latin Glosses', 143-44; P. Rossi, 'Robert Grosseteste and the Object of Scientific Knowledge', in *Robert Grosseteste: New Perspectives on his Thought and Scholarship*, ed. J. McEvoy (Turnhout, 1995), 57-75, at 72-73. In accordance with earlier practice, Grosseteste uses *theorema* when speaking about deductions in geometry: Robertus Grosseteste, *In APo*. 1.1.52 (ed. Rossi, Firenze 1981), p. 95. Note, however, that Nicholas of Amiens is willing to use the term in his theological work.

17) For analyses of this chapter, see also Dod, 'The Study of Aristotle's *Posterior Analytics*', 115-18; Evans, 'The "Conclusiones" of Robert Grosseteste's Commentary', 732-33.

18) Robertus Grosseteste, *In APo*. 1.2 (ed. Rossi, Firenze 1981), pp. 99-104; Arist., *APo*. 1.2, 71b9-72b4.

the existence of demonstration and knowledge, since these facts cannot be treated within the science of demonstration itself.[19] In 1.2, on the other hand, he begins the interpretation and analysis of demonstrative science as such. Almost immediately the structuralizing concepts (definition, supposition and conclusion) play the dominant role in Grosseteste's work.

According to Grosseteste, Aristotle puts forward two definitions and one supposition, on the basis of which he presents the first conclusion of the science of demonstration:

1. Definition 1 (D1): Of knowledge. We have knowledge when we know the cause (*causa*) of some phenomenon *simpliciter*.[20]
2. Supposition 1 (S1): "Everything that is known is known through demonstration."[21]
3. Definition 2 (D2): Of demonstration. "Demonstration is a deduction that produces knowledge."[22]
4. Conclusion 1 (C1): "Demonstrative science is based on principles/premisses that are true, primary, immediate, as well as prior to, better known than and causes of the conclusion."[23]

Thus, Grosseteste clarifies what he believes to be the structure of the *Posterior Analytics* with the use of his conceptual tools: "definition", "supposition" and "conclusion"; and he further believes that the structuralising method that he uses is actually used also in the *Posterior Analytics* itself. That is, he believes that Aristotle himself has structured his work using definitions, suppositions and conclusions, although he has not, of course, explicitly used the terms. Grosseteste defines knowledge and demonstration, a supposition is added to the definition of knowledge, and from these principles he apparently deduces the first conclusion concerning the foundation of demonstrative science. This, to put it briefly, is the procedure and the result of 1.2. On the surface, this is, then, a very clear and fair kind of (demonstrative) interpretation, and to the

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19) *In APo*. 1.1.12-13 (ed. Rossi, Firenze 1981), p. 93: "quia nullius artificis est stabilire suum subiectum vel quod est ante suum subiectum, ne artem transgrederetur…".

20) *In APo*. 1.2.5-8, ed. Rossi, p. 99. Cf. Arist., *APo*. 1.2, 71b9-12.

21) *In APo*. 1.2.29-30, ed. Rossi, p. 100: "[O]mne quod scitur, per demonstrationem scitur"; see also idem, *In APo*. 2.6.76-79, ed. Rossi, p. 406, and Arist., *APo*. 1.2, 71b12-13.

22) *In APo*. 1.2.36-40, ed. Rossi, p. 100: "[D]emonstratio est syllogismus faciens scire". See Arist., *APo*. 1.2, 71b17-18.

23) *In APo*. 1.2.41-42, ed. Rossi, p. 100: "[D]emonstrativa scientia est ex veris et primis et immediatis et prioribus et notioribus et causis conclusionis". Cf. Arist., *APo*. 1.2, 71b19-22.

best of my knowledge it has been generally accepted as such by modern scholars working on the commentary.[24] However, when one examines Grosseteste's commentary more carefully, and compares it with Aristotle's original text, some problems seem to arise.[25] These problems are of two kinds: (1) Problems concerning Grosseteste's interpretation of Aristotle, and (2) problems concerning the demonstrative procedures of Grosseteste's commentary. Both types of problems are treated in the following; most of them are of type 1, but the most important are, in my opinion, the type 2 problems.

D1 (that is, the need to know the cause of some phenomenon *simpliciter*, if we are to have real knowledge) is based on a passage in the Aristotelian text where the Philosopher is actually uncharacteristically clear.[26] Grosseteste, on the other hand, presents a more elaborate description which is designed to pull the reader in a rather different direction from that intended by Aristotle according to most modern interpretations. In fact, D1 is never presented in the form of a single clear proposition; instead Grosseteste simply explains that the purpose of D1 is to state what knowledge is. Thus, he begins with a brief statement:

> The first definition determines what it is "to know", because to know is *per se* the purpose of this science.[27]

This is in complete accord with the Aristotelian text. But then he immediately proceeds to a description of different types of knowledge.[28] The different kinds

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24) See e.g. Dod, 'The Study of Aristotle's *Posterior Analytics*', 102; Evans, 'The "Conclusiones" of Robert Grosseteste's Commentary'.

25) *Contra* Dod, 'The Study of Aristotle's *Posterior Analytics*', 118: "G.'s general analysis is sound. His grasp of the overall structure of the text is impressive, and his basic thesis of a series of 'conclusiones' springing from a fundamental complex of definitions provides a most effective analytical tool, by means of which the important elements in the chapter are brought clearly into focus."

26) Arist., *APo*. 1.2, 71b9-12 (the passage is cited in note 50 below).

27) *In APo*. 1.2.5-6, ed. Rossi, p. 99: "Prima autem definitio est eius quod est scire, quia scire est per se finis huius scientiae".

28) *In APo*. 1.2.9-22, ed. Rossi, p. 99: "Sed non lateat nos quod scire dicitur communiter et proprie et magis et maxime proprie. Est enim scientia communiter veritatis comprehensio, et sic sciuntur contingentia erratica; et dicitur scientia proprie comprehensio veritatis eorum quae semper vel frequentius uno modo se habent, et sic sciuntur naturalia, scilicet contingentia nata, quorum est demonstratio communiter dicta. Dicitur etiam scientia magis proprie comprehensio veritatis eorum quae semper uno modo se habent, et sic sciuntur in mathematicis tam principia quam conclusiones. Cum autem veritas sit illud quod est et comprehensio veritatis sit comprehensio eius quod est, esse autem eius quod dependet ab alio non cognoscitur nisi per esse eius a

of knowledge, Grosseteste says, has different kinds of certainty, ranging from the common usage of knowing the ever-changing particulars to the most certain form of knowledge, which is the demonstrative. This kind of knowledge, about which the term is used in the original and primary sense, is "through understanding of a cause that is immutable in its being and its causal effect".[29] With these words, Grosseteste refers to God, as is clear from the phrasing, and as he has already made clear in 1.1; for there God has been made ultimately responsible for our knowledge of true principles.[30] Thus, even though Aristotle is actually quite clear in this particular passage (*APo*. 71b9-12), and does not, of course, mention or imply the need to refer to any god, Grosseteste changes the focus of the passage by giving only a brief description of Aristotle's view without bothering about the more precise content. Grosseteste also seems to distort Aristotle's view by claiming that all other kinds of knowledge are "sophistical" in comparison with the demonstrative.[31] In the passage in question, Aristotle was focusing on the distinction between *secundum se* and *secundum accidens*, which is not quite the same as the distinction between true and sophistical, as Grosseteste implies. In particular, the knowledge produced by the mathematical sciences is no less certain than the final form in Grosseteste's division, and thus it cannot be categorised as sophistical.[32] And furthermore, Grosseteste focuses not so much on the *cause* as the important part of the definition but rather on the fact that there is a greatest cause (God) which is the original cause of all true knowledge, and in comparison to which all other causes and kinds of knowledge are sophistical. This, as so much else in the commentary, is Augustinian theory,[33] or at least inspired by Augustine, and it

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quo dependet, manifestum est quod maxime proprie dicitur scire comprehensio eius quod immutabiliter est per comprehensionem eius a quo illud habet esse immutabile, et hoc est per comprehensionem causae immutabilis in essendo et in causando".

29) *In APo*. 1.2.21-22, ed. Rossi, p. 99: "per comprehensionem causae immutabilis in essendo et in causando".

30) *In APo*. 1.1.26-36, ed. Rossi, p. 94, in particular lines 32-36: "Nec solum illud voco doctrinam quod ab ore doctoris audimus, sed scripturam etiam loco doctoris accipio; et, si verius dicamus, nec qui exterius sonat docet nec littera scripturae exterius visa docet, sed solum movent haec duo et excitant; sed verus doctor est qui interius mentem illuminat et veritatem ostendit". With this passage, compare e.g. *In APo*. 1.7.96-103, ed. Rossi, p. 139; *In APo*. 1.17.38-48, ed. Rossi, pp. 240-41.

31) *In APo*. 1.2.21-2, ed. Rossi, p. 100: "et respectu huius scire [scil. scire propriissime dictum] vocat Aristoteles alios modos sciendi sophisticos et secundum accidens".

32) Elsewhere, Grosseteste seems to be well aware of this, see *In APo*. 1.11.141-42, ed. Rossi, p. 179: "In solis enim mathematicis est scientia et demonstratio maxime et principaliter dicta".

33) See E. Serene, 'Demonstrative Science', in *The Cambridge History of Later Medieval Philoso-*

has no role to play in Aristotle's text or in an interpretation of it. On an Augustinian view, the principles of knowledge are recognised through the light of God, who is, then, the first and original cause of knowledge. Grosseteste is thinking along similar lines in distinguishing between different levels of causes culminating in the highest one which is "immutable in its being and its causal effect"; and the Augustinian divine light, as is well-known, is echoed throughout the commentary.[34] Aristotle, on the other hand, does not in this place elaborate on his conception of "cause", and his discussions elsewhere show that it is very different from the one that Grosseteste attributes to him.[35] One might at first glance think it strange that Augustine's conception of knowledge and divine light has any part to play in Grosseteste's text, but even apart from the authority of Augustine there are at least two obvious reasons and a third possible, but philosophically more interesting, reason. First, the *Posterior Analytics* and the theory of demonstration that is put forward in this work was not assimilated into medieval thought until well into the thirteenth century (not least as a result of Grosseteste's efforts), and prior to this assimilation Augustine was an important source and inspiration. Thus, it was only natural that he should play a part in the first thorough Western interpretations of the *Posterior Analytics*. Second, one might also speculate that Grosseteste, who was an extremely religious man even for his time, found it satisfying to follow one of the most respected religious authorities even in matters of science. Third, and finally, an Augustinian theory of light solves one of the major problems in Aristotle's theory of demonstrative knowledge: that our cognition of the ultimate principles must be more certain than any knowledge deduced from them. Aristotle could only refer to intuitive cognition (νοῦς) and strong believe (πίστις)[36] as the foundation of certainty; but Grosseteste can argue that God warrants the certainty, and this obviously puts him in a much stronger position than Aristotle's.[37] Still, it must be stressed that, even though divine light

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phy, ed. N. Kretzmann, A. Kenny and J. Pinborg (Cambridge, 1982), 496-517. For warnings against attributing a well-structured and coherent theory of this kind to Augustine, see S. Marrone, *William of Auvergne and Robert Grosseteste. New Ideas of Truth in the Early Thirteenth Century* (Princeton, New Jersey, 1983), 3-23.

34) See e.g. *In APo*. 1.1.26-36 (ed. Rossi, p. 94); *In APo*. 1.7.96-103 (p. 139); *In APo*. 1.17.38-48 (pp. 240-41); *In APo*. 1.19.29-69 (pp. 279-81); *In APo*. 2.6.103-107 (pp. 407-408).

35) See, in particular, Arist., *Phys*. II.3, 194b16-195b30; *Metaph*. V.2, 1012b34-1014a25.

36) As regards πίστις, it should, however, be noticed that the Greek word also signifies proof, albeit in a vague sense. Still, this connotation perhaps made the original Aristotelian theory of cognition of principles seem stronger and more certain than it does to us.

37) On this particular point, see also Serene, 'Demonstrative Science', 503.

is, of course, an un-Aristotelian feature of Grosseteste's theory, the result, i.e. certainty concerning the principles of knowledge, is one that Aristotle would presumably have liked if he had been in a position to accept the reasons for it. This third explanation, then, is the philosophical reason for adopting an Augustinian stance on this particular issue.[38]

The rather long description of different types of knowledge was probably adopted from the Latin translation of Themistius' paraphrase of the *Posterior Analytics* of which Grosseteste made extensive use.[39] The divisions of knowledge are, however, important for Grosseteste for reasons irrelevant to Themistius' purpose, since they make D1 a more substantial foundation for Grosseteste to build on; for the better we understand the concept of "cause", the more solid and convincing will D1 appear. Thus, he has good reasons to discuss and present such divisions of causes, but they are not found explicitly in Aristotle's text.[40]

D2, that is, "demonstration is a deduction that produces knowledge", also suffers from some problems of clarity as well as some additional ones concerned with the demonstrative appearance of the commentary. As regards the

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38) As regards Augustinian influence on Grosseteste in general, see Serene, 'Demonstrative Science', 501-504 and, in particular, Marrone, *William of Auvergne and Robert Grosseteste*. Since the subject is probably the most carefully examined part of Grosseteste's commentary of the *Posterior Analytics*, I shall not, however, go deeper into the matter.

39) J. R. O'Donnell, 'Themistius' Paraphrasis of the *Posterior Analytics* in Gerard of Cremona's Translation', *Mediaeval Studies* 20 (1958), 239-315, at 247-48. See also Hackett, 'Robert Grosseteste and Roger Bacon', 165-66.

40) Dod, 'The Study of Aristotle's *Posterior Analytics*', 118, would even regard this section as a "blemish (from an Aristotelian point of view)". On the other hand, W. Detel, 'Aristotle's Logic and Theory of Science', in *A Companion to Ancient Philosophy*, ed. M. L. Gill and P. Pellegrin (Malden, MA., 2006), 245-69, is a modern interpreter who finds in the *Posterior Analytics* a distinction between perfect science and possible science. For general information about Grosseteste's classifications of different kinds of knowledge, see R. J. Palma, 'Grosseteste's Ordering of *Scientia*', *The New Scholasticism* 50 (1976), 447-63; P. Rossi, 'La classificazione delle scienze in Roberto Grossatesta', in *L'homme et son univers au moyen âge*, vol. II, ed. C. Wenin = *Philosophes Médiévaux* 27 (Louvain-La-Neuve, 1986), 646-51; J. Longeway, 'Medieval Theories of Demonstration', in *The Stanford Encyclopedia of Philosophy (Fall 2005 Edition)*, ed. E. N. Zalta, URL = <http:// plato.stanford.edu/ archives/ fall2005/ entries/ demonstration-medieval/>. A. C. Crombie, *Robert Grosseteste and the Origins of Experimental Science 1100-1700* (Oxford, 1953) contains much interesting material, even if it is out-dated in some parts; see e.g. E. Serene, 'Robert Grosseteste on Induction and Demonstrative Science, *Synthese* 40 (1979), 97-115, and S. P. Marrone, 'Robert Grosseteste on the Certitude of Induction', in *L'homme et son univers au moyen âge*, vol. II, ed. C. Wenin = *Philosophes Médiévaux* 27 (Louvain-La-Neuve, 1986), 481-88, for substantial criticism of central points in Crombie's views.

problems of clarity, Grosseteste begins 1.2 by explicitly stating that Aristotle sets forth two definitions and one supposition as the foundation of the first conclusion.[41] But Grosseteste does not at this point present all of them to the reader in the form of propositions; only D1 is mentioned (and, as I have already argued, this particular definition is not even provided explicitly in the form of a single and clear proposition), and it is obvious from the following text where D2 is presented. In fact, Grosseteste does not use D2 until well into the chapter,[42] and not even then does he identify it explicitly as the definition (D2) to which he previously referred. It is simply stated that a new definition is needed at this point in the text to support S1 and the following part of the commentary; he does not say that the one provided is the fundamental D2.[43] That is, one might easily mistake D2 for a simple supporting definition instead of recognising its fundamental role in the entire argument that Grosseteste's original statement at the beginning of 1.2 implied. In particular, this lack of clarity is bothersome, because D1 is never even explicitly stated in propositional form. That is, we have two definitions: of the first one (a) we are informed about the general, but not about the particular and precise, content, and (b) it is mentioned that this is the definition in question; while for the second (a) we have the precise contents in propositional form, (b) but it is never explicitly referred to as the second definition mentioned at the beginning of the chapter. This is something that the reader will have to figure out for himself. Thus, the hierarchical structure is difficult to follow, or at least not as clear as it could be, even in this crucial part of the commentary in which the foundation of the entire work is laid.

Even more importantly, Grosseteste explicitly states that this definition is put forward because of the previous arguments, and its function is partly to clarify the supposition, as he also states in the text.[44] This produces problems as regards the demonstrative procedure; for, assuming a bottom-up hierarchy[45]

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41) *In APo*. 1.2.1-5, ed. Rossi, p. 99: "Explanato modo quo contingit scire et solvere oppositiones destruentium scire, inchoat Aristoteles scientiam quam intendit in hoc libro docere primo ponens duas definitiones et unam suppositionem, ex quibus consequenter concludit primam conclusionem huius scientiae".

42) *In APo*. 1.2.38-39, ed. Rossi, p. 100.

43) *In APo*. 1.2.36-39, ed. Rossi, p. 100: "Ergo propter explanationem praecedentis suppositionis et propter sequentia subiungit Aristoteles hanc definitionem: demonstratio est syllogismus faciens scire".

44) *In APo*. 1.2.36-38, ed. Rossi, p. 100. See the previous note.

45) Note that the bottom-up hierarchy is used only as an illustration. One might equally well have used a top-down hierarchy to illustrate the point.

with the basic and fundamental elements at the bottom and the derived and secondary above the former, he must as a result place D2 above D1, since the definition of knowledge is a precondition of understanding the content of D2, but presumably below S1 in the hierarchy, since the correct understanding of S1 presupposes D2. But his method in 1.2, then, produces the result that D1 is the fundamental definition to which S1 is added,[46] and only then is D2 added for clarification and future use. Therefore, the original appearance at the beginning of the chapter of these as equals is apparently incorrect. Furthermore, D2 was already used in the discussions in 1.1—which, by the way, are supposed to be discussions that do not use the science in question[47]—without any hint that it was of fundamental importance for the whole work.[48]

The major problem of the foundation presented in 1.2 is, however, S1, which Grosseteste also attributes to Aristotle: that *all* knowledge (*scientia*) comes from demonstrative science. First, this simply cannot be supported by the Aristotelian text.[49] What the Latins actually had from Aristotle's hand, in the translation made by James of Venice, is the following:

> We think we have knowledge *simpliciter* of some object—and not in the sophistical and accidental way—when we think we cognise the cause through which the object is, [that is, when we think we cognise] that it is the cause of the object, and that this cannot be otherwise. Thus, it is clear that to have knowledge is such a thing.[50]

Aristotle claims that we possess knowledge when we recognise the cause of a particular phenomenon, and are aware (1) that this is the sufficient cause of the phenomenon in question, and (2) that the phenomenon must necessarily exist and be exactly as it is when the cause is present. But he does not say anything to indicate that this is the *only* kind of knowledge, or, in fact, that demonstration is the only way to reach such knowledge. In the following part of Aristotle's *Posterior Analytics* 1.2, and in the next chapters, it is clear that this is a question on which he has not yet taken a position; and in the end, he actu-

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46) *In APo*. 1.2.29-30, ed. Rossi, p. 100.

47) *In APo*. 1.1.9-17, ed. Rossi, p. 93.

48) See *In APo*. 1.1.6-9, ed. Rossi, p. 93.

49) Even though he did not understand the *Posterior Analytics* in several other respects, John of Salisbury got this particular point right, see *Metalogicon* 4.8.3-14 (ed. J. B. Hall and K. S. B. Keats-Rohan, Turnhout 1991), 146.

50) Arist., *APo*. 1.2, 71b9-13 (transl. Iacobi): "Scire autem opinamur unumquodque simpliciter, sed non sophistico modo qui est secundum accidens, cum causamque arbitramur cognoscere propter quam res est, quoniam illius causa est, et non est contingere hoc aliter se habere. Manifestum igitur est quod huiusmodi aliquid scire sit".

ally believes that there are other kinds of knowledge.[51] In the passage quoted above, all Aristotle really says is that at least the state that we are in when we cognise the cause of something must be called "knowledge"; but there may still be other kinds. That is, at the fundamental level Grosseteste has made much more specific demands from a theory concerned with obtaining knowledge, and in fact the whole discussion of knowledge at the beginning of 1.2 (see above) also shows that Grosseteste's S1 is a very strong view ignoring the details of the very difficult concept of *scientia*. Furthermore, a little later in the commentary he is seen to be aware of the "the ambiguity of the word 'knowledge'" (*ambiguitas huius nominis 'scire'*), and thus to recognise that not all knowledge derives from demonstration.[52] Thus, Grosseteste must mean that *stricto sensu* all knowledge is a result of the demonstrative syllogism, but even this, as I have indicated, is very doubtful as an interpretation of Aristotle.

Second, it is clear from Aristotle's text that he did not intend the proposition in question as a basic supposition of the Grossetestean kind by means of which the remaining part of the theory of science could be deduced. On the contrary, Aristotle used the phrase to sum up his preceding argument in a sentence that reads more like a summary conclusion than something to be used as one of the fundamental axioms of the entire science in question. Grosseteste, on the other hand, states that the supposition must be adopted on two grounds:[53] (1) the discussion of the deduction (syllogism) in the *Prior*

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51) See *APo*. 1.2, 71b16-17 (transl. Iacobi), and, in particular, 1.3, 72b18-20: "Nos autem dicimus neque omnem scientiam demonstrativam esse…". Grosseteste argues by strengthening the Aristotelian distinction between *intellectus* and *scientia*, and thus claims that there can be no true knowledge (*scientia*) of fundamental principles, only intuitive understanding (*intellectus*): *In APo*. 1.2.91-102, ed. Rossi, p. 103. For a more cautious approach, see Robert Kilwardby's commentary in D. Cannone, 'Le *Notule Libri Posteriorum* di Robert Kilwardby nella tradizione esegetica latina medievale del XIII secolo', vol. II (unpublished PhD Thesis, Rome 2003-2004), p. 13: "Item, bene dicit [scil. Aristoteles] 'doctrina et disciplina' et non 'cognitio', quia non omnis intellectiva cognitio fit ex praeexistente cognitione, sed humana solum. Item, melius dicit 'doctrina et disciplina' quam 'scientia', quia scientia proprie conclusionum est tantum, sed intellectiva cognitio humana est tam principiorum quam conclusionum".

52) *In APo*. 1.3.3-38, ed. Rossi, p. 105; and, in even stronger terms, *In APo*. 1.3.24-38 (p. 106). In the latter passage he explicitly states that it all depends upon what kind of *scire* we are talking about, referring, of course, to the distinctions made at the beginning of 1.2 (see the discussion above).

53) *In APo*. 1.2.29-39, ed. Rossi, p. 100: "Consequenter subiungit Aristoteles hanc suppositionem: 'omne quod scitur, per demonstrationem scitur'. Haec autem suppositio partim sumitur a libro Priorum et partim cognoscitur in cognoscendo quid est quod dicitur per hunc terminum 'demonstratio'. Demonstratur enim in *Analeticis Prioribus* quod omne quod cognoscitur postquam fuit dubium vel opinionis contrariae per syllogismum cognoscitur; ergo, cognito quod demonstratio

Analytics, and (2) some sort of cognition that arises when one comes to recognise the meaning of "demonstration" (*demonstratio*); for, Grosseteste says, in the *Prior Analytics* it is shown that every recognition of something that was previously doubtful or unknown occurs through a deduction, and by D2 demonstration is the deduction that produces knowledge. These two points combine to establish S1, according to Grosseteste.

However, this explanation seems to cause some obscurity; for the condition that some sort of cognition arises when one comes to recognise the meaning of "demonstration" by its own nature presupposes D2, that is, "demonstration is a deduction that produces knowledge", which Grosseteste has not even stated yet. Of course, adding D2 to clarify S1 is a valid method of demonstration, but at the very least the hierarchy between the basic definitions and suppositions is unnecessarily blurred by this procedure, and a circular argument threatens. One should also notice the peculiar uses of "therefore" (*ergo*) in the relevant passage.[54] The first (l. 34) helps to state the conclusion that S1 is recognised as soon as one recognises the truth of D2; and *therefore* (l. 36) Grosseteste simply posits D2 as a fact. This would appear to be somewhat like saying: "We need X to establish Y; therefore X."

Still, on this foundation (*His… principiis positis*), Grosseteste states C1, that is, the first of 64 conclusions (32 in each book): "Demonstrative science is based on principles/premisses that are true, primary, immediate, as well as prior to, better known than and causes of the conclusion." This is in accordance with Aristotle's work. But in Aristotle the conclusion is based simply on the description and analysis of demonstration, and his foundation is less complicated—or, one might perhaps say, not as rigidly deduced. Grosseteste conceives C1 strictly as a direct consequence of D1-2 and S1 on the basis of a chain of thought like the following: (a) Since knowledge consists of recognising the sufficient, eternal, immutable and exact cause(s) (D1), one must naturally seek such cause(s), if one wants to obtain knowledge;[55] (b) and the road to knowledge must go through demonstration (S1);[56] (c) finally, it has been established that demonstration is a special kind of deduction, that is, a special kind of the *syllogismus* that Aristotle describes and analyses in the *Prior Analytics*,

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est syllogismus faciens scire, non potest esse dubium quin quicquid scitur, per demonstrationem sciatur. Ergo propter explanationem praecedentis suppositionis et propter sequentia subiungit Aristoteles hanc definitionem: demonstratio est syllogismus faciens scire".

54) See the text in note 53.

55) *In APo*. 1.2.22-24, ed. Rossi, pp. 99-100.

56) *In APo*. 1.2.29-30, ed. Rossi, p. 100.

viz. deductions from well-structured premisses to a conclusion (D2).[57] (d) Knowledge of an object as the result of knowing its cause is therefore identical with knowing a conclusion through knowing the principles of this conclusion (C1). That is, the conclusion is, in Grosseteste's view, directly derived from D1-2 and S1. Still, even though Grosseteste has certainly with this analysis elaborated the foundation of C1 beyond Aristotle's own text, he has done so in an Aristotelian spirit. The features described above, and not least the clear-cut road which leads to C1, are to a large extent Grosseteste's own elaboration, but they are not *per se* un-Aristotelian. In particular, one may notice that C1, the fundamental and most important conclusion of the entire commentary, is a statement which is found in Aristotle's own text (see above).

Even this truly Aristotelian C1 is, however, unclear in important respects. The theories of the *Posterior Analytics* and of Grosseteste's commentary both belong to material logic, not to purely formal logic, and thus the premisses must not only be well-formed; they must also be true and live up to other demands imposed by reality. Therefore, Grosseteste (following the Aristotelian text) feels forced to add a number of conditions that the premisses must fulfil, if they are to honour the demands of D1-2 and S1 (see the following). But the whole intention in a deductive system of this kind is that the conclusions follow naturally and clearly from the premisses, in this case D1-2 and S1, and the need for further clarification proves that this has not happened in Grosseteste's 1.2.

In fact, and most importantly, C1 contains a number of undefined predicates of demonstrative knowledge: "true", "primary", "immediate", "prior to", "better known than" and "causes", and more are added as Grosseteste proceeds, e.g. "necessary", "universal", "eternal", "incorruptible" etc.[58] These are not clarified and substantiated until the following part of the commentary; in particular, quite a substantial part of the commentary on book 1 (1.1-1.11) is used to treat these predicates; that is, a section of almost 90 pages is used to clarify, discuss and substantiate the foundation of C1.[59] Grosseteste knows very well, and even tries to defend the fact, that the following part of the

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57) *In APo*. 1.2.36-40, ed. Rossi, p. 100.

58) See the text in the next note.

59) *In APo*. 1.2.61-1.11.296, ed. Rossi, pp. 101-87. See *In APo*. 1.12.1-8 (p. 188): "A principio libri usque ad locum istum [= *APo*. 1.1-11, 71a1-77a35] demonstravit Aristoteles quod demonstratio est ex primis et veris et immediatis et prioribus et notioribus et causis et necessariis et per se inhaerentibus et universalibus et perpetuis et incorruptibilibus et ex propriis tam principiis quam interrogationibus et conclusionibus; et hae omnes conditiones non aggregantur simul nisi in demonstratione maxime et propriissime dicta, quae acquirit scientiam propriissime dictam, secundum quod diffinitum est scire in principio".

commentary constitutes a clarification and an analysis of C1,[60] but this brings him dangerously close to a circular argument of the kind that an Aristotelian philosopher must reject: If the following *conclusiones* are to be directly deduced, or at least derived, from C1, then they cannot themselves on Aristotelian and Euclidean principles be used to clarify the first conclusion;[61] they would have to be definitions or suppositions instead of conclusions. But if they are not deduced/derived from C1, the axiomatic hierarchy of *conclusiones* would seem to be an illusion, and Grosseteste will have instead a number of equally fundamental principles of science and scientific theory.

In fact, it should be noticed that Grosseteste himself may have been aware that the deduction of C1 from D1-2 and S1 is not as clear-cut as he would have liked it to be. For in the introduction to the chapter, before the analyses proper, he states unhesitatingly that the conclusion is established "from these" (*ex quibus*), that is, from D1-2 and S1.[62] But after having stated and analysed D1-2 and S1 he no longer says "from these", but instead he informs us that C1 "is added" (*subnectitur*) as the result of the former principles. This seems to be a much weaker description on Grosseteste's part.

At first sight, then, Book 1, chapter 2, of Grosseteste's commentary appears to be the solid foundation of a demonstrative theory of knowledge. But when the particulars are examined a little more closely, there would seem to be substantial problems. First, one might dispute some essential parts of Grosseteste's interpretation of Aristotle's text. Second, and much more importantly, the demonstrative procedures of the commentary sometimes, and in crucial respects, seem questionable, in particular concerning the conclusions.

III. Aristotle's Intention and Demonstrative Sciences

Grosseteste was no fool. On the contrary, he was a singularly independent and clear-headed thinker.[63] Therefore, the problems connected with D1-2, S1 and

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60) See *In APo*. 1.2.51-64, ed. Rossi, p. 101: "Praedicatum autem huius primae conclusionis, quia coniunctum est ex multis, dividitur ut particulatim facilius probetur, sicut pluries fit in scientiis demonstrativis; et postquam considerata fuerint singula particulatim, manifesta erit haec propositio: omne faciens scire est ex veris et primis et immediatis et prioribus et notioribus et causis conclusionis…".

61) See Evans, 'The "Conclusiones" of Robert Grosseteste's Commentary', 732: "The essence of Euclid's method is the demonstrable dependence of all more advanced principles upon those earlier shown to be either self-evident or to be themselves dependent upon self-evident first principles."

62) See the text in note 41 above.

63) On the more general aspects of Grosseteste's thought, see e.g. J. McEvoy, *The Philosophy of*

C1 are not simply mistakes or careless work on his part. I suggest that Grosseteste has two, partly interrelated reasons for structuring 1.2 (and the commentary in general) the way he does.

First, one must consider the nature of the *Posterior Analytics* and what Grosseteste wants to accomplish with his exposition. The *Posterior Analytics* is one of the most difficult Aristotelian works, and the structure and coherence of the text are not easily established. Nowadays most scholars would argue, I suppose, that this is partly at least because the treatise is not a finished work, perhaps not even a single work but rather several treatises brought together by Andronicus of Rhodes or some other editor.[64] But, Aristotle being the author of the text, Grosseteste reasonably expected coherence in the work, and if it was not easily found, it was most likely because we did not understand the Philosopher rightly. It is the job of the commentator to bring out this coherence of the work clearly to the reader, and a demonstrative exposition is by far the most compelling way of doing so. But, for Grosseteste (although perhaps he did not consciously see it that way[65]), this produced a clash between a literal interpretation of the often rather difficult and (seemingly) incoherent text and the clear intentions of the Philosopher, *viz*. the construction of a demonstrative theory of science and a theory of how one demonstrates. I think it is certain that Grosseteste believed that he perceived Aristotle's intentions, and they were what he primarily expounded.[66] That is, Grosseteste comments on what he *perceives* to be Aristotle's theory, not so much on the *text* itself. But, even though Grosseteste is exceptionally good at this, it sometimes makes the commentary incompatible, or at least not easily compatible, with the Aristotelian original. This explanation, *viz*. that Grosseteste works on the basis of his own perception of Aristotle's intention rather than on the basis of the text itself, also accounts for some of the most striking features of the commentary: (a) Grosseteste's method of commenting is unusually personal, and he himself

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Robert Grosseteste (Oxford, 1982); *Robert Grosseteste: New Perspectives on his Thought and Scholarship*, ed. J. McEvoy (Turnhout 1995).

64) *Aristotle's Prior and Posterior Analytics*, ed. with introd. and comm. D. Ross (Oxford, 1949), 6-23, 75; *Aristotle: Posterior Analytics*, transl. with comm. J. Barnes (Oxford, 1993^{2} [1975^{1}]) xi-xxii.

65) But see *In APo*. 1.9.1-177, ed. Rossi, pp. 162-69, for a chapter which indicates that Grosseteste did perhaps sometimes consciously embrace this procedure.

66) See the very first words of the commentary, *In APo*. 1.1.1-2, ed. Rossi, p. 93: "Intentio Aristotelis in hoc libro est investigare et manifestare essentialia demonstrationis". Generally, phrases such as "intentio Aristotelis" or "intendit Aristoteles" are frequently found in the commentary.

takes responsibility for many of the arguments;[67] (b) the commentary is very general and rarely pays close attention to individual passages and phrases in Aristotle's text.[68] These features are striking if one compares Grosseteste's commentary with those of later thirteenth-century thinkers such as Robert Kilwardby or Thomas Aquinas. One might say that Grosseteste is making the Aristotelian theory appear more coherent than it actually is by rhetorical means and by avoiding close literal comments. But this would certainly not be Grosseteste's own view of the situation, and it would not be completely fair either. For in many instances he may very well be right about the Aristotelian intention.

Second, and related to the former point, different demonstrative methods were, as stated in the "Introduction" above, available in the twelfth and thirteenth centuries. Of the three kinds of demonstrative treatises previously mentioned, the *Posterior Analytics* itself belongs to type 1, namely texts that both demonstrate and teach how to demonstrate, and Grosseteste's commentary ought to belong to the same category.[69] But the analysis of Grosseteste's 1.2 above revealed a number of difficulties concerning the hierarchy of definitions, suppositions and, in particular, conclusions. C1 is supposed to be the basis of later *conclusiones*, but these are often used to clarify and expand on C1, which should not be possible on a traditional axiomatic-deductive theory of type 1. Thus, type 1 in the above list of demonstrative sciences in the twelfth century[70] must be supplemented by type 3, which is actually more suited to describe Grosseteste's commentary. It is certainly constructed as a deductive system, and on a first reading it would appear that each conclusion is derived from the preceding one(s). But on further analysis, the conclusions are actu-

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67) See e.g. *In APo*. 1.1.26-36; 1.2.77-102; 1.5.1-82, ed. Rossi, pp. 94, 102-103, 117-20. In these passages and in many others Grosseteste settles the problems in sections beginning with an explanation of the problem and then a *dico*-section, that is, "Here is my (authoritative) view". On Grosseteste lending his own authority to the argument, see also R.W. Southern, *Robert Grosseteste. The Growth of an English Mind in Medieval Europe* (Oxford, 1992[2] [1986[1]]), 37-38, citing the thirteenth-century Oxford Franciscan William of Alnwick.

68) On this point, see also Evans, 'The "Conclusiones" of Robert Grosseteste's Commentary', 730-31; Ebbesen, 'Medieval Latin Glosses', 143-44. *Contra* Dod, 'The Study of Aristotle's *Posterior Analytics*', 98 ("primarily an *ad litteram* exposition of Aristotle's text").

69) Dod, 'The Study of Aristotle's *Posterior Analytics*', 102-103 and Serene, 'Robert Grosseteste on Induction', 104 and 115 n. 35 (citing John Longeway for the same view), seem to think that it is a particularly clever and interesting move by Grosseteste to use the theory of the *Posterior Analytics* to expound the very same text. But, as I stated in the "Introduction" above, this kind of demonstrative procedure (that is, demonstrating and teaching how to demonstrate) was well-known also in the twelfth century.

70) See the "Introduction" above.

ally interrelated in ways that do not always make it clear which are primary and which are derived from the others, or rather: which make it clear that there is not always such a hierarchy. However, it seems that D1 alone is never disputed or thought to need additional support, and in this respect too Grosseteste's commentary resembles type 3 (that is, in using a single fundamental principle for the entire theory, like the *Liber de Causis*, while the relationships between the deduced conclusions are more uncertain).[71]

The commentary is a combination of nos. 1 and 3, then, but even more can be said about its specific nature, and in particular about the nature of the *conclusiones*. Euclid's *Elements* provided the twelfth century with the most important example of applied demonstrative science, that is, type 2 in the list. However, Euclid was not simply Euclid in the twelfth century.[72] The first known version was Boethius' translation, but it was only partial, and importantly almost all the proofs were missing, that is, the readers could not see how the individual theorems were derived from previous theorems. In the course of the twelfth century, the *Elements* was translated several times, and the tradition was rather unstable with frequent contamination from the different sources for the text. As regards the most widely used version of the *Elements* (Version II), Charles Burnett makes the following important remark:

> The most widely copied twelfth-century version of the *Elements* omits Euclid's proofs altogether and replaces them by instructions showing the reader which earlier theorems to use in order to obtain the proof. The framework of the argument is given, but the reader is left to fill in the details himself.[73]

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71) See also *In APo*. 1.2.5-8, ed. Rossi, p. 99: "Prima autem definitio est eius quod est scire, quia scire est per se finis huius scientiae; finem autem oportet esse primum in intentione et cognitione, quia secundum exigentiam finis convenit omnia cetera moderari"; *In APo*. 1.12.1-8, ed. Rossi, p. 188: "A principio libri usque ad locum istum demonstravit Aristoteles quod demonstratio est ex primis et veris et immediatis et prioribus et notioribus et causis et necessariis et per se inhaerentibus et universalibus et perpetuis et incorruptibilibus et ex propriis tam principiis quam interrogationibus et conclusionibus; et hae omnes conditiones non aggregantur simul nisi in demonstratione maxime et propriissime dicat, quae acquirit scientiam propriissime dictam, secundum quod definitum est scire in principio".

72) On the reception of Euclid in the Middle Ages, see note 8 with references.

73) Burnett, 'Scientific Speculations', 161. See also e.g. S. Brentjes, 'Remarks about the Proof Sketches in Euclid's *Elements*, Book I as Transmitted by Ms. Paris, B. N., fonds latin 10257', in *Mathematische Probleme im Mittelalter. Der lateinische und arabische Sprachbereich*, ed. M. Folkerts (Wiesbaden 1996) 115-37; C. Burnett, 'The Latin and Arabic Influences on the Vocabulary Concerning Demonstrative Argument in the Versions of Euclid's *Elements* associated with Adelard of Bath', in *Aux origines du lexique philosophique européen. L'influence de la latinitas*, ed. J. Hamesse (Louvain-La-Neuve, 1997), 117-35.

Grosseteste's commentary is very much indebted to Euclid's *Elements*. Evans has even suggested that Grosseteste tried to "superimpose Euclid upon Aristotle as a means of tidying and ordering what Aristotle is saying" by "following the sequence of Aristotle's argument but maintaining his own progression from *conclusio* to *conclusio*".[74] I think this is exactly right, but only in the sense of the Euclid who, in the words of Burnett, "omits Euclid's proofs", perhaps not "altogether", since Grosseteste often posits arguments and explanations, but to a certain extent, and in particular the lack of proof is a very conspicuous feature of the very first and most important conclusion of the commentary in 1.2. We cannot at present say precisely which versions of Euclid were known to Grosseteste,[75] but he clearly had very good sources when it came to obtaining even rare works. Thus, he cannot have been unfamiliar with this kind of Euclidean tradition.

Euclid's *Elements* seems, then, to have methodologically inspired Grosseteste, but this text may not be the only inspiration for type 2 elements in the commentary. In the *De Hebdomadibus*, one of the most important texts on demonstrative science used by scholars of the twelfth century, Boethius explicitly claims to use a mathematical deductive method.[76] Thus, he states nine *regulae* from which he claims to be able to deduce the conclusions that he needs. But it is notable that Boethius never actually explains which *regulae* to use and how to use them in the individual passages. Instead he wants the reader to perform this task himself;[77] that is, Boethius has given him the fundamental axioms and the conclusions that should be reached, but he has not told him when and where the individual *regulae* are to be used. This was left to the twelfth-century commentators on the text, and they all did so; Clarembald of Arras, in particular, with much zeal, but neither Thierry of Chartres

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74) Evans, 'The "Conclusiones" of Robert Grosseteste's Commentary', 731. For Euclidian influence on Grosseteste's commentary, see also P. Rossi, 'Un contributo alla storia della scienza nel Medioevo', *Rivista di filosofia neo-scolastica* 67 (1975), 103-10.

75) But see W. R. Knorr, 'Falsigraphus vs. adversarius: Robert Grosseteste, John of Tynemouth, and Geometry in thirteenth-century Oxford', in *Mathematische Probleme im Mittelalter. Der lateinische und arabische Sprachbereich*, ed. M. Folkerts (Wiesbaden, 1996), 333-59.

76) Boethius, *De Consolatione Philosophiae, Opuscula Theologica*, ed. C. Moreschini (Munich-Leipzig, 2000), 186-94, at 187. For a translation, see Boethius, *The Theological Tractates and the Consolation of Philosophy*, ed. H. F. Stewart, E. K. Rand and S. J. Tester (Cambridge, Mass., 1973[2] [1918[1]]), 38-51, at 38-41.

77) Boethius, *De Consolatione Philosophiae, Opuscula Theologica*, 188: "Sufficiunt igitur quae praemisimus; a prudente vero rationis interprete suis unumquodque aptabitur argumentis". See also Evans, 'Boethian and Euclidean Axiomatic Method', 37, 43-44, who is, however, mistaken in saying that a similar procedure is not found in the Euclidean tradition.

nor Gilbert of Poitiers ignores the task.[78] The Boethian method, then, is not a clear-cut example of the type 1 demonstrative science described in the "Introduction" above; for it also contains features that are very similar to the Euclidean ones described as type 2, and these texts—Boethius' and Euclid's—were well-known in the twelfth century. There can be no doubt that Grosseteste was acquainted with both of them.

Thus, the *conclusiones* of Grosseteste's commentary may be conceived as theorems by their author, but the demonstrative arguments to prove them are often lacking. Even though he is sometimes careful to point out the connections between the individual definitions, suppositions and conclusions there is often no real argument involved; it is done simply by using words and phrases such as *consequenter* or *subnectitur haec conclusio*.[79] To repeat, these are not demonstrative arguments but rather "instructions showing the reader which earlier theorems [that is, in Grosseteste's case, definitions, suppositions, explanations and conclusions] to use in order to obtain the proof" (Burnett cited above). I believe that this particular feature of the commentary also explains at least most of the difficulties that the analysis of book 1, chapter 2, revealed. For if the relationships between the definitions, suppositions and conclusions, were clear to Grosseteste, as indeed he felt they were (see also the "Conclusion" below), then it may sometimes have escaped him that not every single one of his conclusions could be demonstratively deduced, the reason for the oversight being that he followed the procedure of some versions of Euclid's *Elements*, and was most likely also inspired by Boethius' *De Hebdomadibus*, and this may be the reason why he did not explicitly state the proofs. But still, he knew that the conclusions were right; that is, not only were they Aristotelian, they were simply true.

It seems, then, that Grosseteste's commentary is the result of several influences, and these are, or so I have tried to argue, much more intricately connected and combined than has so far been suspected. When one adds the fact that Grosseteste was one of the most remarkable individuals of medieval thought, it is no wonder that the commentary is truly *sui generis*.[80]

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78) For the texts, see the editions mentioned in note 6. On the commentaries, see also Evans, 'Boethian and Euclidean Axiomatic Method', 43-44. For earlier commentaries on Boethius' *Opuscula Sacra*, see E. K. Rand, *Johannes Scottus* (Munich, 1906).

79) Evans, 'The "Conclusiones" of Robert Grosseteste's Commentary', 733.

80) Interestingly, Grosseteste's commentary on the *Physics* seems to consist of notes for a similar structure, but, as is well-known, it is transmitted in a much less finished state than the commentary on the *Posterior Analytics*. See Roberti Grosseteste *Episcopi Lincolniensis Commentarius in VIII Libros Physicorum Aristotelis*, ed. R. C. Dales (Boulder, Colorado, 1963).

IV. Conclusion

All this adds up to a rather peculiar mixture of praise and blame of Grosseteste's commentary on the *Posterior Analytics*. His commentary is not always easy to use as an aid to understanding the original Aristotelian text, but it is the first extant Latin commentary on this treatise,[81] it is a remarkable intellectual effort, and the commentary was very influencial in the later scholastic treatment of the text. Prior to Grosseteste's work, we know of no Latin scholar to have mastered this Aristotelian treatise; on the contrary, there is much evidence that scholars usually avoided it throughout the twelfth century, and when they did not, they often made bad mistakes of interpretation.[82] Grosseteste's interpretation may be somewhat idiosyncratic, and it may not generally satisfy the modern reader as an interpretation of Aristotle. Perhaps the medievals were not themselves completely satisfied, because the methodology and structure of Grosseteste's commentary is apparently not found in any commentaries of the following century;[83] in this context it is perhaps also significant that the methods of Alain of Lille's *Regulae Caelestis Iuris* and of Nicholas of Amiens *Ars Fidei Catholicae* were apparently not reproduced either in the theological literature.[84]

But certainly Grosseteste did in fact master the *Posterior Analytics* in his own way, and to him the text was, as Evans points out,[85] luminously clear. That is, Grosseteste truly grasped many Aristotelian intentions, and although he sometimes went too far in his interpretations, in particular as the result of his

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81) On a possible commentary by James of Venice, see S. Ebbesen, 'Jacobus Veneticus on the *Posterior Analytics* and Some Early thirteenth Century Oxford Masters on the *Elenchi*', *CIMAGL* 21 (1977), 1-9 for the argument in favour. I have presented an argument against such a commentary in D. Bloch, 'James of Venice and the *Posterior Analytics*', *CIMAGL* 78 (2008) 37-50. At least parts of Philoponus' commentary on the *Posterior Analytics* had been translated by James, and Grosseteste used them, but only fragments are now extant. See S. Ebbesen, 'Anonymus Aurelianensis II, Aristotle, Alexander, Porphyry and Boethius. Ancient Scholasticism and twelfth Century Western Europe', *CIMAGL* 16 (1976), 1-128, at 89-107; P. Rossi, 'Tracce della versione latino di un commento greco ai *Secondi analitici* nel *Commentarius in Posteriorum Analyticorum Libros* di Roberto Grossatesta', *Rivista di filosofia neo-scolastica* 70 (1978), 433-39; S. Ebbesen, 'New Fragments of "Alexander's" Commentaries on *Analytica Posteriora* and *Sophistici Elenchi*', *CIMAGL* 60 (1990), 113-20.

82) I plan to treat the early reception of the *Posterior Analytics* in a future article.

83) See Ebbesen, 'Medieval Latin Glosses', 143-44, who also points out some of the most interesting Grossetestean features of later periods; in particular, Walter Burley's commentary on the *Politics* has some interesting affinities with Grosseteste's commentary on the *Posterior Analytics*.

84) See Evans, 'Boethian and Euclidean Axiomatic Method', 36.

85) Evans, 'The "Conclusiones" of Robert Grosseteste's Commentary', 734.

Augustinian inclinations and his divine light metaphysics, he often produced a more vivid and coherent theory of demonstration than was ever found in the original Aristotelian treatise or in any other commentary on the text. Aristotle's *Posterior Analytics* has been hailed as "one of the most brilliant, original, and influential works in the history of philosophy";[86] Grosseteste's is one of the few commentaries on this text which actually shows why this statement is true, while also making an independent contribution to the theory of demonstration. His commentary gave the Latin tradition of the *Posterior Analytics* not only a very capable and inspiring beginning but also a challenging one.

[86] Jonathan Barnes in *Aristotle: Posterior Analytics*, transl. with comm. J. Barnes (Oxford, 1993^2 [1975^1]) xiv.